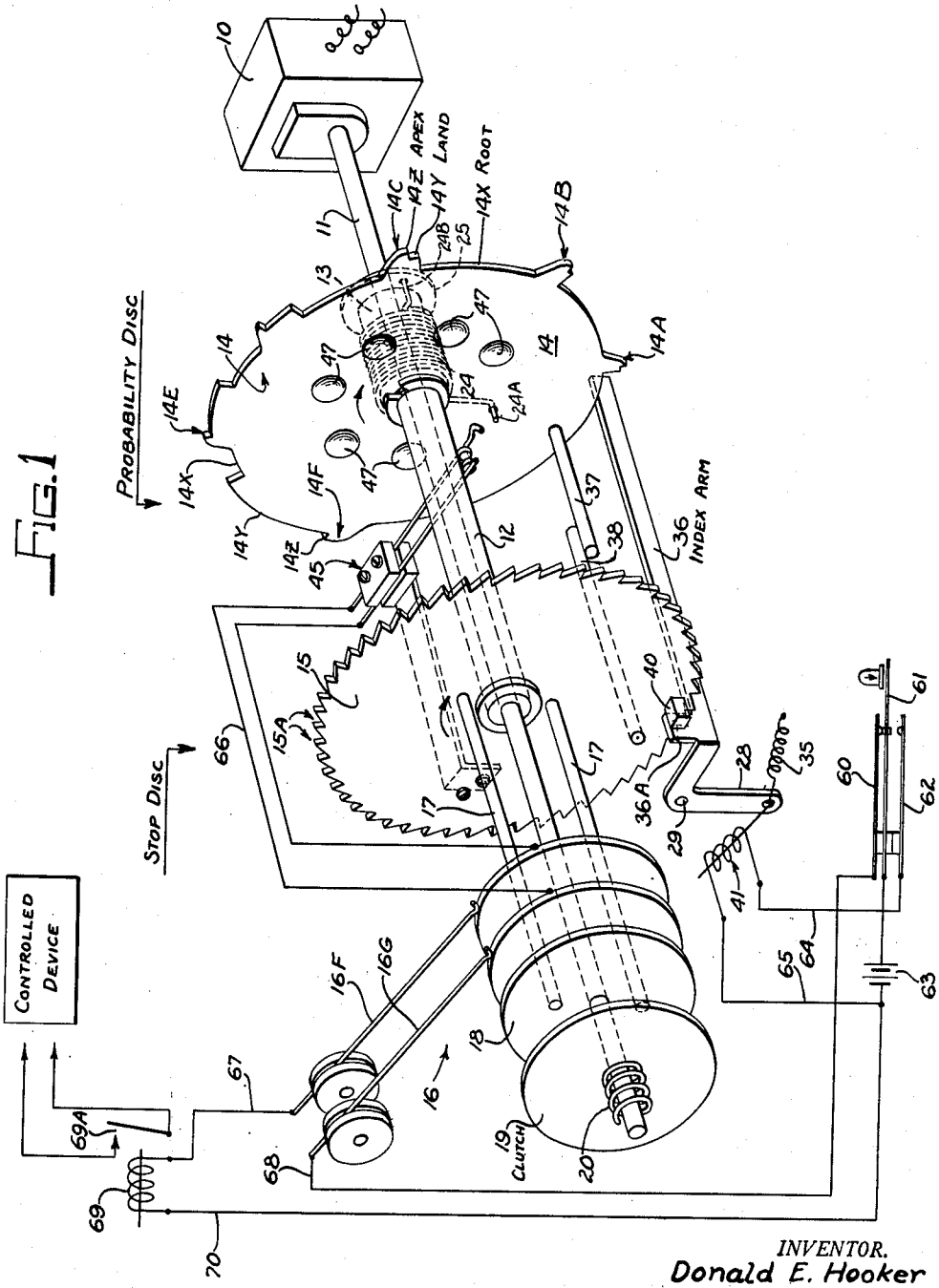
June 24, 1952 D. E. HOOKER 2,601,524

PROBABILITY AND PROPORTIONING SWITCH

Filed Jan. 19, 1950 4 Sheets-Sheet 1

FIG. 1



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PROBABILITY AND PROPORTIONING SWITCH

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FIG. 2

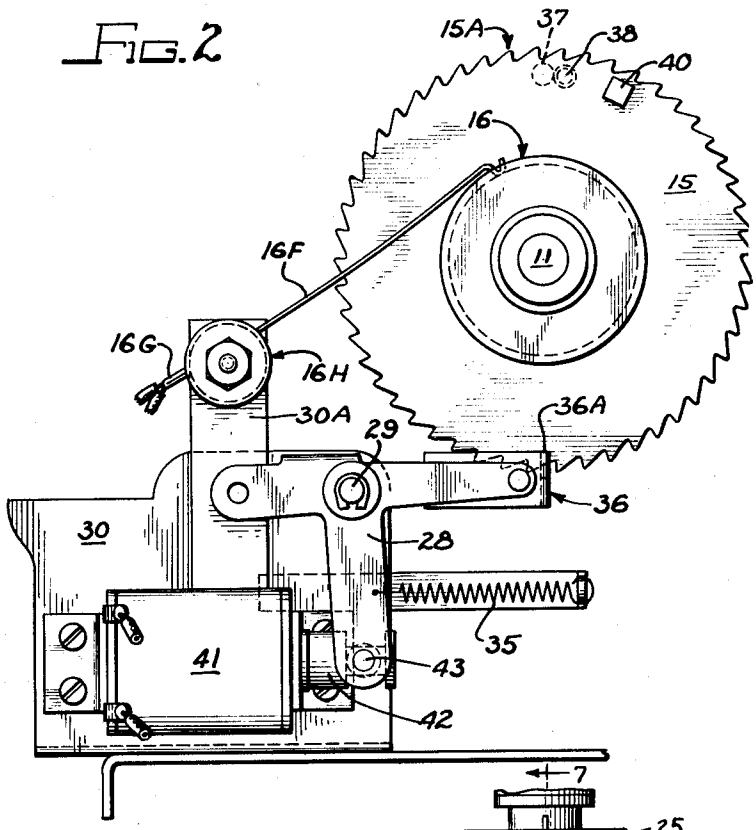
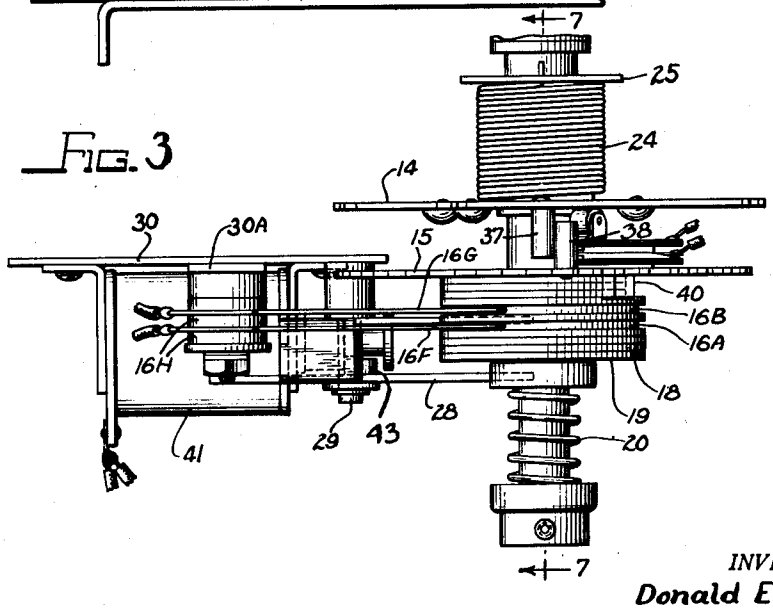


FIG. 3



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PROBABILITY AND PROPORTIONING SWITCH

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FIG. 4

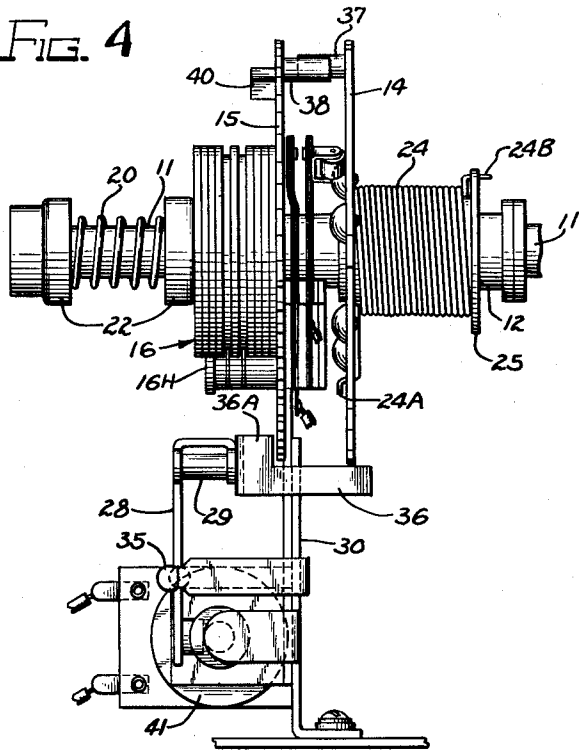


FIG. 5

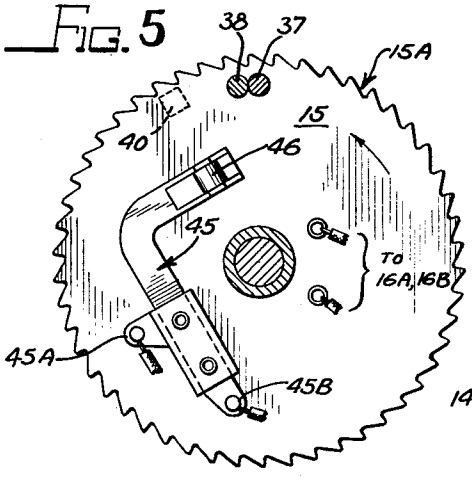
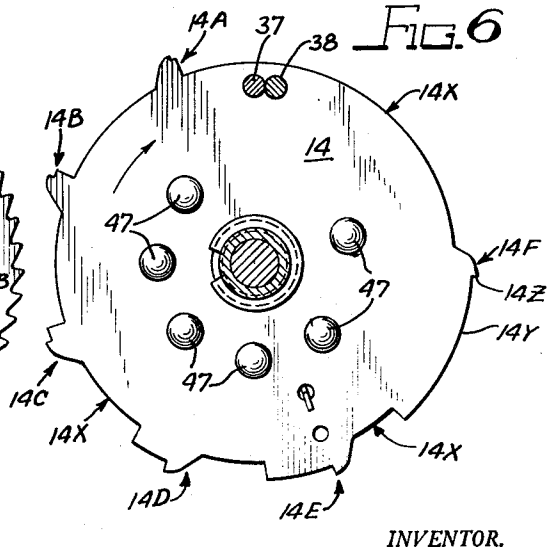


FIG. 6



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PROBABILITY AND PROPORTIONING SWITCH

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Fig. 7

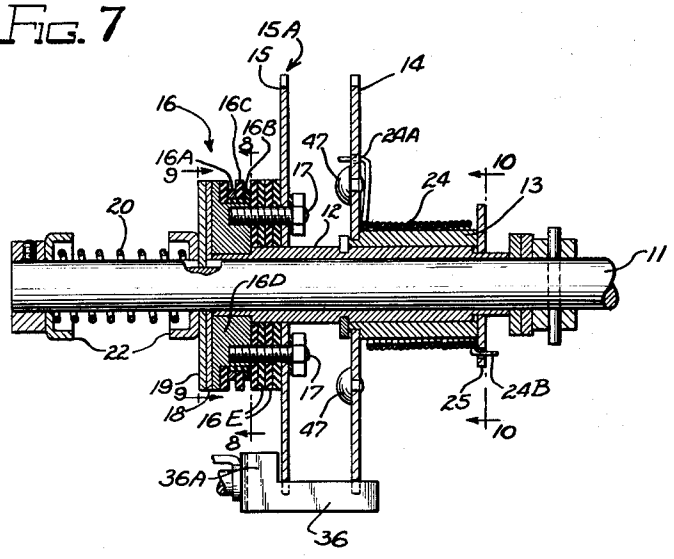


Fig. 8

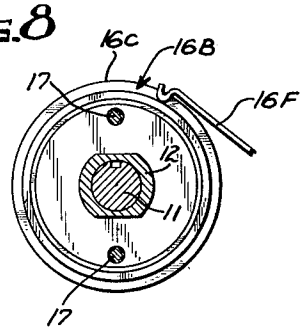


Fig. 9

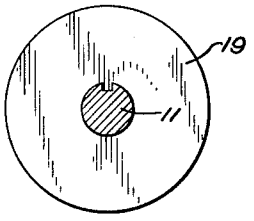
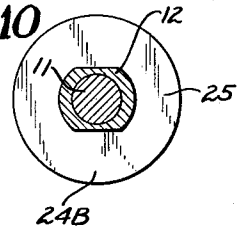


Fig. 10



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Patented June 24, 1952 2,601,524

UNITED STATES PATENT OFFICE

2,601,524

PROBABILITY AND PROPORTIONING SWITCH

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Application January 19, 1950, Serial No. 139,423

23 Claims. (Cl. 200—92)

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This invention has as its principal object the provision of a motor-driven circuit control unit in the nature of a rotary switch contrived to afford predetermined probabilities of procuring various numbers of control pulses for each cycle of operation thereof without regard to how frequently or rapidly the cycling may occur, or whether the cycling is random or regulated.

Viewed from another aspect, the disclosure provides a probability and proportioning switch of general application, but which has been applied in particular to amusement apparatus for the purpose of modifying the opportunities for scoring at certain times or in a certain field of play, for example in bowling or shuffle games, or in a ball-rolling game having a plurality of game switches adapted to be closed by a ball, where the switches may be connected in various groups intended to have different scoring values at different times.

A detailed object is the provision of a probability switch consisting basically of a pair of discs, clutch-driven and impositively coupled to rotate together, but also rotatable relative to each other, with an indexing brake which involves the probability of stopping both discs or only one disc in a given cycle of operation, and indexing means such that, should one disc (called the probability disc) be stopped, then the other (called the stop disc) would continue to rotate certain proportioned angular distances for the remainder of the cycle to yield various predetermined numbers of control pulses through a switch on one disc and operating responsive to relative movement of the other disc.

Another detailed object is the provision, in a probability and proportioning switch, of a probability disc having two peripheral levels of indexing contact on which an index brake pawl may ride, the peripheral index-riding surfaces or lands at one of these levels being of different arcuate lengths, calculated on the basis of one complete relative revolution of a companion stop disc, to yield a predetermined fixed ratio of probabilities for getting 1, 2, 3 . . . N switch pulses per cycle, such that whenever the indexer is released for stopping action there will be a definite percentage relationship between the lengths of arc which may be probably engaged to stop one of the discs, and the resultant arc of travel remaining for the other disc until the latter is also stopped.

Another object is to provide a probability and proportioning switch unit operable to give fixed probabilities of getting different pulse counts

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by means of a simplified probability and pulse proportioning mechanism which eliminates a good deal of equipment, such as rotary commutating switches having variously connected groups and banks of pulse contacts, and associated relay and transfer switching mechanism required heretofore for these purposes.

Another object is the provision of a proportioning switch consisting of a pair of coaxially rotatable discs and slip-clutch means for rotating said discs simultaneously from a motor shaft, an index brake normally stopping both discs until the brake is released for a cycle of operation, one of the discs, called the probability disc, also being rotatable relative to the other disc, called the stop disc, the index brake being operable so that it may at times stop only the probability disc or both discs, and there being an impulse switch which is operated only as a result of movement of the two discs relative to each other, the number of switch pulses resulting from such relative disc motion depending upon which one of several proportioning stop teeth is engaged on the probability disc, and the amount of relative displacement obtained during the cycle between the two discs (before they complete their pulsing cycle following each complete operation of the indexer) determining how many pulses will be produced by the switch, the proportion of pulses yielded always being in a fixed ratio to the permitted amount of travel remaining for the stop disc after the probability disc has been stopped.

Additional objects and aspects of novelty pertain to structural and functional details of the embodiment illustrated in the annexed drawings, in which:

Fig. 1 is an exploded, schematic, perspective of the switch unit and illustrative circuit connections therefor;

Fig. 2 is an end view, in elevation, of the unit showing the index clutch and stop disc;

Fig. 3 is a fragmentary top plan view of the unit looking down upon the parts of Fig. 2, and showing in addition the probability disc and spring therefor;

Fig. 4 is a sidewise elevation of the parts shown in Fig. 3;

Fig. 5 is an inside elevational view of the stop disc showing the pulse switch;

Fig. 6 is an inside elevational view of the probability disc showing the probability teeth and switch-operating studs;

Fig. 7 is a vertical sectional detail through the

disc assembly, looking in the direction of lines 7—7 of Fig. 3;

Figs. 8, 9, and 10 are sectional details through the concentric shaft structure and taken respectively along lines 8—8; 9—9; and 10—10 of Fig. 7.

Referring to Fig. 1, the control assembly includes a motor 10 with built-in reduction gear to drive a long shaft 11, on which is a primary sleeve 12, there being a secondary sleeve 13 fitted freely on the said primary sleeve 12.

A probability disc 14 is mounted fast on the secondary sleeve 13, and a stop disc 15 is mounted fast on the main sleeve 12 and is provided with peripheral indexing teeth 15A.

Actually, the two discs 14 and 15 are closely in juxtaposition as shown in Fig. 7, wherein the aforesaid sleeve and shaft structures are also clearly shown.

A commutator ring assembly 16 is rigidly joined by bolts 17 to the stop disc 15, and this assembly includes a slip clutch friction disc 18 driven by a similar drive disc 19 pressed into frictional driving engagement therewith by a spring 20 working (as in Fig. 7) between cup washers 22 on shaft 11, the clutch disc 19 being keyed fast on shaft 11 so that the tendency is to cause the stop disc 15 and primary sleeve 12 to rotate with the drive shaft 11, unless restrained as by the index brake.

The probability disc, as shown in Fig. 7, is pro vided with a torsion spring 24 having one end 24A anchored to the disc and its other end 24B anchored in a key washer 25 fast on the primary sleeve 12, as a result of which (among other things) the probability disc 14 tends to rotate in step with the stop disc 15, since the driving effort of the main shaft is transmitted through the slip clutch means 18—19—20 to the stop disc and primary sleeve, while effort of the main shaft through the primary sleeve, the keyed washer and the torsion spring likewise tends to rotate the probability disc 14 at the same rate. Certain normally interengaged stop pins on the discs also afford an impositive coupling means for the discs, as will presently appear.

Index brake means for holding and cycling the discs includes a lever 28 (Figs. 1 and 2) pivoted at 29 and urged by spring 35 to project an index arm 36 into the stop disc teeth 15A, and also into certain peculiarly shaped probability teeth 14A, 14B, etc., to be described in detail hereinafter, whereby the stop disc is normally restrained from rotating, as also is the probability disc, owing to engagement of stop pins 37 and 38 on the two discs, said stop pins, as well as the torsion spring means constituting yieldable coupling means for said discs, effective under different condition to permit or prevent relative motion of dics 14 and 15.

Should the index arm 36 not lodge in the root of the probability teeth, the stop disc would continue to rotate a limited amount, and the probability disc might likewise be permitted a predetermined amount of relative displacement, depending upon which probability arc or land the indexer has lodged.

Thus, there is the possibility of relative angular displacement as between the stop and probability discs when only the stop disc is arrested by the index arm.

However, this relative angular displacement between the two discs 14 and 15 is limited to a maximum of 360°, by reason of a pair of stop pins 37 and 38 (Figs. 1 and 3) on said discs; and actually, for reasons to appear, said relative disc displacement is further limited) in the illustrative embodiment) to something slightly less than 360° by an index or cycling stop.

It is important to observe in Fig. 1 that the stop disc 15 has an additional stop 40 on the opposite side thereof from the stop pin 38 and spaced angularly or in a circumferential sense from the latter a predetermined amount as depicted more precisely in Fig. 2. Stop 40 is called the index or cycling stop.

Said cycling stop 40 engages an index projection 36A on the index arm when the latter is in partly raised or normal stopping position, as in Fig. 1.

Means for releasing the index brake includes a solenoid 41 (Figs. 1 to 4) having plunger 42 (Fig. 2) pivotally linked at 43 to the index lever 28, such that when the solenoid is energized from an auxiliary control circuit, the index arm 36 is rocked down or clockwise in Fig. 1, thus freeing both discs 14 and 15 for joint rotation, which will continue indefinitely so long as the index brake is thus retracted. Nothing else happens at this time, although for convenience such a release of the index brake may be considered as the initiation or starting of a control cycle.

At this juncture, it is desirable to refer to the constructions shown in Figs. 5 and 6, and to observe that on the inside of the stop disc 15 is the impulse switch 45 of the leaf-spring variety, one of the contact blades of which is provided with a roller 46 positioned to travel over switch-operating studs 47 arranged in a circle on the inside face of the probability disc 14, such that when these discs are relatively moving the switch will be closed a number of times, depending upon the relative angular displacement permitted, and how many studs 47 the switch roller 46 passes over.

The peculiar formation of the probability teeth 14A, B . . . F, in accordance with Fig. 6, is characterized by the provision of three peripheral levels (considering the tooth 14F) starting with the root portion or main periphery 14X of the disc, and rising to the next higher (or radially greater) level or arcuate land 14Y, and ending with the still higher (radially greater) apex or stop portions or peaks 14Z.

Still regarding Figs. 5 and 6, it is to be understood that the root depth (radial depth) of the teeth 15A on the stop disc is substantially the same as the root depths 14X on the probability disc.

Thus, if the index arm after a release thereof, happens to lodge back in the root portion 14X it will also lodge in the root level of one of the teeth 15A, and both discs will stop at once, because their respective stop pins 37 and 38 are normally engaged (owing to effort of the torsion spring 24), and the probability disc cannot move if the stop disc is arrested.

If, however, it is assumed that the index pawl 36 lodges on one of the arcuate lands or probability arcs, such as 14Y, the index is prevented thereby from dropping in between any of the stop disc teeth 15A, in consequence of which the stop disc will continue to rotate. But it is also important to observe in this situation that the probability disc will continue to rotate until the apex or peak portion 14X (in this example) advances against the index arm and stops the disc 14, while the companion stop disc 15 continues for a limited rotation until the index stop 40 strikes the index arm projection 36A, which will be sufficiently elevated (when the index rides on a land) for this purpose.

In the former example, where both discs stopped at once (index at root levels), no switch pulses whatever will result; but in the latter example, where the index rides on a land, pulses will result—how many depending on which land is engaged, and where the index stop 40 happens to be at the time the index pawl falls on the land (i. e. close to, or remote from, the corresponding apex or peak 14Z).

Referring to Fig. 6, it will be observed that the maximum number of pulses in the embodiment chosen is six, there being only six of the studs 47, and these are situated relative to the stops and distributed relative to the different lengths of land arc so that the shortest arcs tend to yield the largest number of pulses, there being six lands. In this instance, the difference in arcuate length of the lands for probability teeth 14A and 14B is barely perceptable, but the relative differences become greatly marked toward the end of the series of teeth (at 14F).

The probability of the index pawl 36 lodging in the very small notches afforded by the shorter lands on teeth 14A, 14B, is much less than that for teeth 14E or 14F, for instance; yet the proportion of pulses which will result, should the index fall onto any of the lands rather than onto the root level, will always be fixed because the ratio of the arcuate lengths of the lands to the permitted terminal or homing travel for the stop disc, once the probability disc is stopped, is always fixed by the angular location of the index stop 40.

In the actual construction, as depicted in Fig. 7, the assembly is completed by certain circuit connections through the commutator 16, the latter in this instance consisting of two brass contact rings 16A, 16B separated by an insulating disc 16C of larger diameter, and also flanked by similar discs, so that said contact rings lie in annular grooves.

The commutator contact rings 16A, 16B are clamped between the assembly of insulating discs by a header 16D, which is pulled up by bolts 17 against the filler discs 16E, and tight against the stop disc 15.

As in Figs. 2 and 3, there are provided a pair of spring commutator wipers 16F and 16G clamped between insulating collars 16H secured to a post 30A (Fig. 2) on plate 30, the free ends of these contact springs riding respectively on corresponding commutator rings 16A or 16B.

The impulse switch 45 (Fig. 5) has two contact blade terminals 45A and 45B which are connected respectively to one of the commutator rings 16A or 16B by connection pins (not seen) extending into the commutator disc assembly and into engagement with each of the rings.

Operation

An illustrative circuit arrangement is depicted in Fig. 1, which is best explained by describing the operating cycles.

Assuming motor 10 to be running, main drive shaft 11 turns continuously carrying clutch disc 19 with it, and tending thereby to rotate the stop disc 15 through the other clutch discs 18, etc., and tending to turn sleeve 12.

However, the index arm 36 is normally raised by spring 35 to engage in stop disc teeth 15A, so that the stop disc is restrained against rotation.

The probability disc 14 and the secondary sleeve 13 are turned by the torsion normalizing spring 24 (refer to Fig. 7 here) until stop pin 37 abuts stop pin 38 on the stop disc, because the key washer 25 is fast on the primary sleeve and anchors one end of said normalizing spring, so that the effort of the other end thereof is free to rotate the floating probability disc and its own or secondary sleeve 13 the amount permitted by said stop pins.

In this condition of the discs, the index arm 36 will also be lodged at the root level on the probability disc, for reasons to appear, as a result of normalizing action of the torsion spring 24 at the beginning of each operating cycle, to turn the probability disc relative to the stop disc until pins 37 and 38 engage.

The index solenoid may be energized by pushing down on the button of the master switch (Fig. 1) so that contact blade 61 engages contact 62 to close circuit from battery 63 and connect power via conductor 64 to one terminal of solenoid 41, the remaining terminal of the solenoid being connected by conductor 65 to the return connection with battery or power source 63.

Energization of index coil 41, as aforesaid, rocks the index lever 28 clockwise, withdrawing the index arm 36 fully from all disc teeth, and at once the two discs 14 and 15 rotate in step, and will continue to do so until the coil 41 is deenergized and the index arm is released for return by its spring toward normal indexing position.

If now it is assumed that the index arm 36 falls fully down (up) into the root level (i. e. 14X), it will also drop into the root of stop teeth 15A, and both discs 14 and 15 will stop at once, and no impulsing whatever of switch 45 occurs.

However, should the index arm fall onto the intermediate radial level or arcuate land 14Y, the probability disc 14 would be quickly stopped when the associated apex or tooth 14Z abutted the index arm, but the stop disc would continue to rotate because the radial level of the land 14Y (and of all lands) is too great to permit the index arm to drop in between any of the teeth 15A, and accordingly, the stop disc 15 continues to turn, and the two stop pins 37 and 38 now begin to draw apart.

Now, by reason of the probability disc 14 standing still, and the stop disc 15 continuing to turn, the resultant relative angular displacement of these two discs causes the switch roller 46 to ride over one or more impulse studs 47 to close switch 45 a corresponding number of times; conductors 66 (Fig. 1) leading from the switch terminals 45A, 45B to the corresponding commutator rings 16A and 16B, from which the circuit is extended via spring wipers 16F and 16G and conductors 67 and 68 to an energizing circuit for the coil 69 of a pulse relay, power for which is connected from source 63 via conductor 70 through coil 69, and via conductor 67 through the commutator and impulse switch means 45A, 45B, 16A, 16B, 16F, 16G, conductor 68, and master switch contact 60 closed with contact 61 back to the power source 63, it being noted that contacts 60 and 61 are normally closed.

Thus, the number of operations of the impulse switch 45 effected by relative motion of the discs 14 and 15 will energize the impulse relay means 69 a corresponding number of times, causing operation or closure of impulse relay contacts 69A accordingly, for purposes of controlling a desired instrumentality, indicated in the block labeled "Controlled device," it being assumed that the master switch button is only momentarily depressed to start the cycle, so that contacts 60 and 61 may close to restore the impulse relay

circuit through the impulse switch, contacts 60 and 61 being opened merely to prevent operation of the relay during normalizing motion of the discs.

The number of pulses thus afforded by switch 45 depends upon which of the lands associated with the probability teeth 14A . . . 14F the index arm engages, if any, it being recalled that the longer land arcs yield the fewer pulses according to the predetermined distribution of impulse studs 47 relative to the several lands and their angular distance relative to the index stop stud 40. This arrangement is arbitrary and may be determined empirically for any desired application of the device, depending upon the probability and proportioning percentages desired.

The aforesaid proportioning of the number of pulses inversely to the length of the land may be modified or reversed. In the present embodiment it is desired that the device yield the greater number of pulses less frequently, it being now apparent that this is accomplished by reason of the fact that there is less probability of the index lodging upon the shorter lands with which the larger number of pulse studs are associated, as aforesaid.

For example, the probability disc may be designed in this respect to yield zero pulses about 80 per cent of the time; one pulse about 10 per cent of the time; two pulses about 5 per cent of the time; three pulses about 4 per cent of the time; four pulses about 1 per cent of the time, and so-on.

Now, it will be understood that when the disc 14, only, is arrested by the index arm following a starting release of said arm to initiate a cycle, the primary sleeve continues to rotate because disc 14 is not fast, but floats thereon, and in consequence, the normalizing torsion spring 24 is wound through turning of the key washer 25, and this winding action will be limited or stopped when the pins 37 and 38 are in reverse abutment, after the stop disc has turned (relatively) through the nearly one revolution permitted by said pins.

Considering only this much of the aforesaid result of such relative disc displacement, it will now be apparent that the index arm will hold the two discs in this relative condition (with spring 24 wound up) until such time as a new cycle is initiated and the index arm is released, this latter action resulting in freeing both discs, with the added result that the normalizing torsion spring 24 will immediately turn the probability disc 14 back to its normal starting position relative to the stop disc 15 with the stop pins 37 and 38 in the normal abutment (as distinguished from the aforesaid reverse abutment) shown in Fig. 2.

Thus, each initial cycling release of the index will cause a restoration and normalizing of the relative starting positions of the two discs 14 and 15 if said discs have been relatively displaced. In those instances where the very short arcuate index lands (as in tooth 14A) have been involved, the restorative, normalizing travel of the probability disc is very slight and conversely, with the teeth (e. g. 14F) having the longer lands.

Resuming the description of the functional results flowing from relative angular movement of the two discs 14 and 15, as aforesaid, it is important to note the effect of the indexing stop or stud 40, and to observe that because of its location relative to the pin stop 38, it is possible for this stop 40 to be disposed on either side of the index projection 36A at a time when the relative displacement of discs 14 and 15 starts, so that the stop disc 14 may be permitted greater or lesser amounts of travel (up to about 360°) before this stop 40 strikes the index stop 36A, and the impulse studs 47 are angularly distributed and located relative to the probability lands (e. g. 14Y) to yield the aforesaid inverse pulse counts, e. g. one pulse when tooth 14F (having the longest land) is involved, or six pulses when the tooth 14A (having the shortest land) is involved, etc.

Each operating cycle begins with a release of the index arm, followed by a normalizing of the discs to relative starting positions (where there has been a relative displacement), and the cycle may be considered terminated when both discs 14 and 15 come to rest following a release of the index arm, it being observed, however, that such coming to rest may occur in one of two ways: either by a stoppage of the stop disc by root-homing of the index arm, or by a terminal homing or stoppage of the stop disc by the index stop 40, as described above.

Thus, it will appear that probabilities for procuring any pulses at all, or any particular number of pulses, are determined by the arcuate lengths, distribution, and number of lands afforded for engagement of the index arm or pawl; and the number of pulses yielded is a function of the distribution and number of pulse studs 47 in relation to the lands and the index stop 40.

The invention is not limited to the precise details of construction and operation disclosed, for the number and distribution of the pulse studs, as well as the probability pattern as determined by the length and distribution of the probability lands, may be varied considerably according to the particular requirements of any given application of the switch unit. Moreover, the invention contemplates that the pulse and probability ranges may be increased, with corresponding possibilities of variations, by enlarging the size or number of the relatively movable disc elements and expanding the capacity for impulse studs and probability teeth, and various arrangements thereof.

I claim:

1. A rotary switch device comprising two coaxially rotatable discs, one carrying a pulse switch and the other carrying switch-operating pulse studs, said switch being operated as a result of relative turning of said discs, slip-clutch drive means tending to rotate a first one of said discs, means yieldingly coupling said discs for joint rotation by said drive means, index means cooperable with both discs to engage teeth therein, the teeth on each disc being formed with respect to radial depths such that said index means may engage said teeth variously to stop one disc only, or to stop both discs, index stop means for limiting the displacement of one disc when turning relative to the other, and means for normalizing said discs automatically to a relative starting position following each relative displacement thereof.

2. In a rotary switch, a pair of coaxially rotatable discs, disc-actuated switch means operable by rotary motion of one disc relative to the other, power means tending to rotate said discs jointly and index means cooperable with said discs and normally arresting both discs, and operable by an auxiliary control to release the discs for joint rotation, and means on the discs co-

operable with said index means following operation thereof by said auxiliary control to stop one disc during joint rotation thereof, whereby to effect operation of said switch means.

3. In a rotary switch, in combination, at least two members having toothed formations thereon mounted for coaxial rotation, slip clutch drive means for rotating one of said members, an index brake coacting with said members and toothed formations on all of the same so as to hold one or both of said members against rotation depending upon which tooth formations are engaged by said brake, means on said members coupling one of the same with the other to drive the same jointly when said brake is released, and permitting rotation of one of said members relative to the other when one member only is stopped by said brake, and impulse switch means actuated only by rotative movement of one of said members relative to the other.

4. A switch in accordance with claim 3 and further characterized in that said coupling means includes coacting stops abutting in a starting position with one said member in a predetermined position of rotation relative to the other, and one of said members is provided with normalizing spring means tensioned by relative displacement of said members from starting position to restore the same to starting position when said brake is released.

5. The structure of claim 3 further characterized by the provision on one of said members of an index stop cooperable with said index brake when the latter is actuated to hold one member so that said members are moving relatively, to stop the moving one of said members.

6. In a rotary switch, a driven shaft, a pair of discs rotatable on said shaft, yieldable clutch means driving one of said discs, means impositively coupling said discs for joint rotation such that either disc may be held while the other turns, coacting switch and switch-actuating means carried by said discs and operable to actuate the switch means as a result of turning of one disc relative to the other, and brake means cooperable with said discs to hold one or both of the same against rotation by said driven shaft.

7. The construction of claim 6 in which said brake means includes stop means coacting with that one of the discs which is not held against rotation while the other is held, to limit the rotative displacement of the relatively rotating disc to a predetermined angular amount, whereby to establish an operating cycle for the discs during which a predetermined maximum number of switch operations may occur, and angularly spaced proportioning formations on the held disc, and cooperable with said brake means, and dependent upon limiting action of said stop means, to determine the number of switch operations to result from relative displacement of said discs during any operating cycle thereof.

8. In a rotary switch, a pair of juxtaposed discs mounted for rotation, means for rotating said discs jointly and for rotating a certain one of the discs alone, switch means including parts associated with both discs and actuated only by rotation of said certain disc relative to the other with the latter at rest, to give a variable number of pulses depending upon the angular relation of said discs at the start of said relative rotation, and index means cooperable with both discs to hold the same at rest, and operable to release the same for joint rotation, and thereafter stop one disc and permit the certain other disc to continue rotation a limited amount, together with normalizing means cooperable with said index means and operable to set said discs in a predetermined angular relationship prior to each starting of joint rotation thereof.

9. A rotary type switch for use in a probability and proportioning unit and including coaxially rotatable discs one of which has peripheral stop teeth of a predetermined radial depth and located at a certain radial distance and the other of which has peripheral lands lying at a greater radial distance, each land lying at a radial level situated between a stopping apex and the root level of the said stop teeth, a drive shaft common to the discs, yieldable clutch and coupling means tending to rotate said discs together from said shaft, an index arm common to said discs and engageable in said stop teeth to prevent rotation of both discs, and further engageable with any of said lands to hold the corresponding disc without engaging in said stop teeth, whereby the disc having the stop teeth is free to rotate while the other disc is held, control switch means including cooperative switch parts carried by said discs and operable in switch action only responsive to rotation of one disc relative to the other, and means for actuating said arm for effecting engagement and disengagement thereof variously with said teeth and land formations to effect a holding or joint rotation of both discs, or to hold one disc relative to the other.

10. A switch according to claim 9 and in which said lands are of increasing angular length about the periphery of the corresponding disc and the said switch parts thereon include a plurality of switch-operating studs angularly distributed in a predetermined relation to said lands.

11. A switch in accordance with claim 10 and in which said discs have mutually engageable stops, and one of said discs is spring-urged to normalize said discs to a starting relation with said stops mutually engaging during joint rotation of the discs.

12. A switch according to claim 11 and in which that certain one of the discs which is free to rotate while the other is held by the index arm has an index stop engageable with an index member on said arm while the latter is engaged on a land to limit the free rotation of the certain disc relative to the held disc.

13. A switch according to claim 12 and further including electromagnetic actuating means for said index arm and an auxiliary control circuit for said electromagnetic means and connected to be opened and closed by said control switch means.

14. A probability and proportioning switch comprising a stop disc having peripheral stop teeth with root levels, a probability disc having peripheral probability teeth each adjoined by an arcuate land differing in length from each other, each land being adjointed by a root periphery, said discs floating on a driven shaft, a slip clutch driving said stop disc from said shaft, means yieldingly coupling said probability disc to the stop disc for joint rotation therewith, said coupling means including interengageable normalizing stops on both discs and torsion spring means acting on the probability disc to rotate the same to starting position with said stops interengaged, and an index arm pivotable into and out of engagement with root portions of both discs and the lands of the probability disc, the index arm when engaged with a land being thereby prevented from engaging a stop tooth on the stop

disc so that the latter is free to rotate relatively while the arm holds the probability disc, switch means associated with both discs and operated only by relative rotation of one disc with respect to the other, and cooperative index stop means on the stop disc and index arm operating to limit the rotation of the stop disc relative to the probability disc.

15. A switch of the class described including a stop disc and a probability disc on a common shaft means, yieldable clutch and coupling means for driving the discs from the shaft means and permitting holding of the probability disc while the stop disc rotates, together with index and stop means for the discs and operable to initiate and terminate an operating cycle in which said discs are first held at rest, then freed for joint rotation, and then either both stopped or the probability disc stopped while the stop disc rotates a limited angular distance, there being a pulse switch on one disc and cooperative switch pulsing means on the other disc for actuating the switch only when one disc rotates relative to the other, and commutator means for connecting a controlled instrumentality to the pulse switch.

16. A rotary switch mechanism comprising at least two coaxially aligned rotatable members, switch means including cooperable parts on said members operating said switch means responsive to relative turning of one of the members with respect to the other; drive means including a yieldable clutch device for rotating a first one of said members; means including a yieldable coupling between said members such that the first and driven member tends to turn the second member with it; releasable brake means for holding the first member against any rotation; stop means for the first member and cooperable with said brake means for permitting a predetermined limited amount of rotation of the first member responsive to a release of the brake means; and angularly spaced stopping formations on the second member cooperable with said brake means, in a condition of release which permits turning of said first member, for holding the second member against rotation whilst permitting a limited amount of rotation of the first member as aforesaid to effect a relative turning of said members for actuation of the switch means as aforesaid.

17. In a rotary switch device, a shaft and a first disc jointly rotatable therewith, a second disc coupled yieldingly to said shaft to follow and rotate with the first disc, switch means including interacting parts on both discs and actuated by movement of one of said discs with respect to the other, means transmitting and applying a yieldable driving torque to said shaft, releasable means movable relative to said discs and normally holding said first disc against rotative movement, stop means cooperable with releasable means and said first disc for permitting limited turning of the latter under condition that said releasable means is moved into a predetermined releasing position relative to said first disc, another stop means including spaced parts on the second disc and a part positioned by said releasable means and cooperable with said second disc to stop the same against rotation at a plurality of different positions of rotative travel thereof during rotation of the first disc, whereby relative turning of said disc results for actuation of said switch means, and cooperating limit-stop means on said discs for limiting the relative rotative displacement thereof with respect to each other.

18. In a rotating switch device, a first disc coupled to a driven shaft for turning the disc, means applying a yieldable driving force to said shaft, a second disc coupled yieldingly to said shaft by a helical spring and normally urging the second disc to follow and turn with the first disc provided the second disc is not restrained; mutually interacting switch means carried by said discs and operable in switching action as a result of turning of one of the discs relative to the other, cooperable disc-indexing limit means on the discs whereby the second disc, urged by said spring, is indexed in a normal starting position relative to the first disc; releasable brake means cooperable with both discs, and positionable in at least two cooperating positions relative to angularly spaced braking and stop parts on said discs and which are cooperable with said brake means in said cooperating positions thereof for either stopping both discs or stopping the second disc whilst permitting the first disc to rotate a limited amount depending upon the angular situations of said stop parts relative to said brake means at the time said second disc is stopped as aforesaid, whereby to produce various amounts of turning displacement of one disc relative to the other to actuate said switch means, said spring acting responsive to a certain release movement of said brake means, which frees the second disc, at least, to restore the second disc to said starting position, following relative displacement of the discs as aforesaid.

19. A rotary switch device including at least two coaxially rotatable discs, means yieldingly coupling said discs for joint and independent rotative displacement, means for driving one of said discs, angularly spaced stopping formations on both discs, a brake device movable into and out of braking relation to said discs and the stopping formations thereon, the latter on one disc being characterized by a predetermined radial parameter relative to a radial parameter characteristic of the stopping formations on the other disc such that when said brake device is in a first position both discs may rotate, and when in a second position, one of said discs is stopped while the other is free to turn, and when in a third position both discs are stopped, the said stopping formations on one disc also having a prescribed angular extent and spacing serving, when engaged by a part of said brake device, to maintain the brake in said second position to permit relative displacement of the discs, together with control means including cooperative parts operatively associated with both said discs and actuated by relative displacement thereof as aforesaid.

20. A switch including at least two concentrically and relatively rotatable members, means yieldingly driving a first one of the members; inter-member stop means limiting the permitted relative rotational displacement of said members with respect to each other; means yieldingly urging and displacing the second one of said members relative to the first said member to the limit permitted by the limiting stop means aforesaid so as to dispose said members in a normal relative angular starting relation, said urging means also coupling said rotatable members for joint rotation but yieldable to permit holding the second member whilst the first member turns; switch means operatively associated with both members, and including plural operating parts on at

least one said member, whereby said switch means is actuated one or more times by angular movement of one said member in traveling faster than the other said member, the number of times said switch means is actuated in the permitted limited range of relative angular displacement of said members being a function of the amount of such displacement in said range; means for releasably holding the first and driven one of said members against rotation by said driving means; means cooperable with said holding means for restraining rotative movement of said second member by the first member whilst the latter is rotatively moved, and a second stop means for arresting the rotative movement of said first member after a predetermined angular amount of displacement thereof relative to said second member, following each operation of said holding means, to arrest the second member as aforesaid; and radially situated land and teeth formations of different arcuate length and angular situation on the second member cooperable with said releasable holding means to position the latter to arrest the second member at certain times during rotative motion of the first member without stopping the latter, whereby relative switch-actuating displacement is effected between said members by an overrunning of the first member relative to the second member, said yieldable coupling means turning the second member to the limit permitted by said first stop means to overtake the first member and restore said angular starting relation between said members upon subsequent release of the holding means following each stopping of both members in condition of relative angular displacement from said starting relation by said holding means, together with means for actuating the holding means as aforesaid.

21. In a rotary switch, first and second concentrically rotatable discs and means yieldingly coupling the same for joint rotation and also for limited individual rotative displacement relative to each other, switch means including parts carried by both discs and coacting in switch operation responsive to rotation of one disc while the other is stationary; releasable brake means common to both discs and movable into and out of braking positions relative thereto and further cooperable with certain arresting formations on

the second disc to arrest the latter and hold the brake means ineffective relative to the first disc whereby to permit continued rotation and overtravel of the latter; and stop means moved by the overtraveling disc into stopping engagement with said brake means to stop the overtraveling disc in various positions of angular displacement relative to the arrested disc, depending upon the angular relation between said stop means and said arresting formations on the second disc at the time the second disc is stopped, whereby said switch means is actuated dependently upon relative angular displacement of said discs, one with respect to the other, and also upon the degree of such angular displacement, together with means for releasing and applying said brake means.

22. Apparatus according to claim 21 in which said arresting formations are spaced at different angular positions of arcuate travel on the second disc and are of predetermined variable arcuate length to hold said brake means ineffective relative to the first disc for different periods of arcuate travel of the second disc, whereby the amount of overtravel of the first disc may be automatically varied to modify the actuation of said switch means, determined at least by the interval of angular travel occurring between a release and reapplication of said brake means.

23. Apparatus according to claim 21 in which said switch means and operating parts thereof carried by said discs includes a contactor carried by one disc and a plurality of contactor-operating members carried by the other disc and spaced angularly at various predetermined positions to actuate the contactor a number of times depending upon the amount of relative angular displacement between said discs responsive to arrest of the one disc and overtravel of the other disc as set forth.

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The following references are of record in the file of this patent:

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